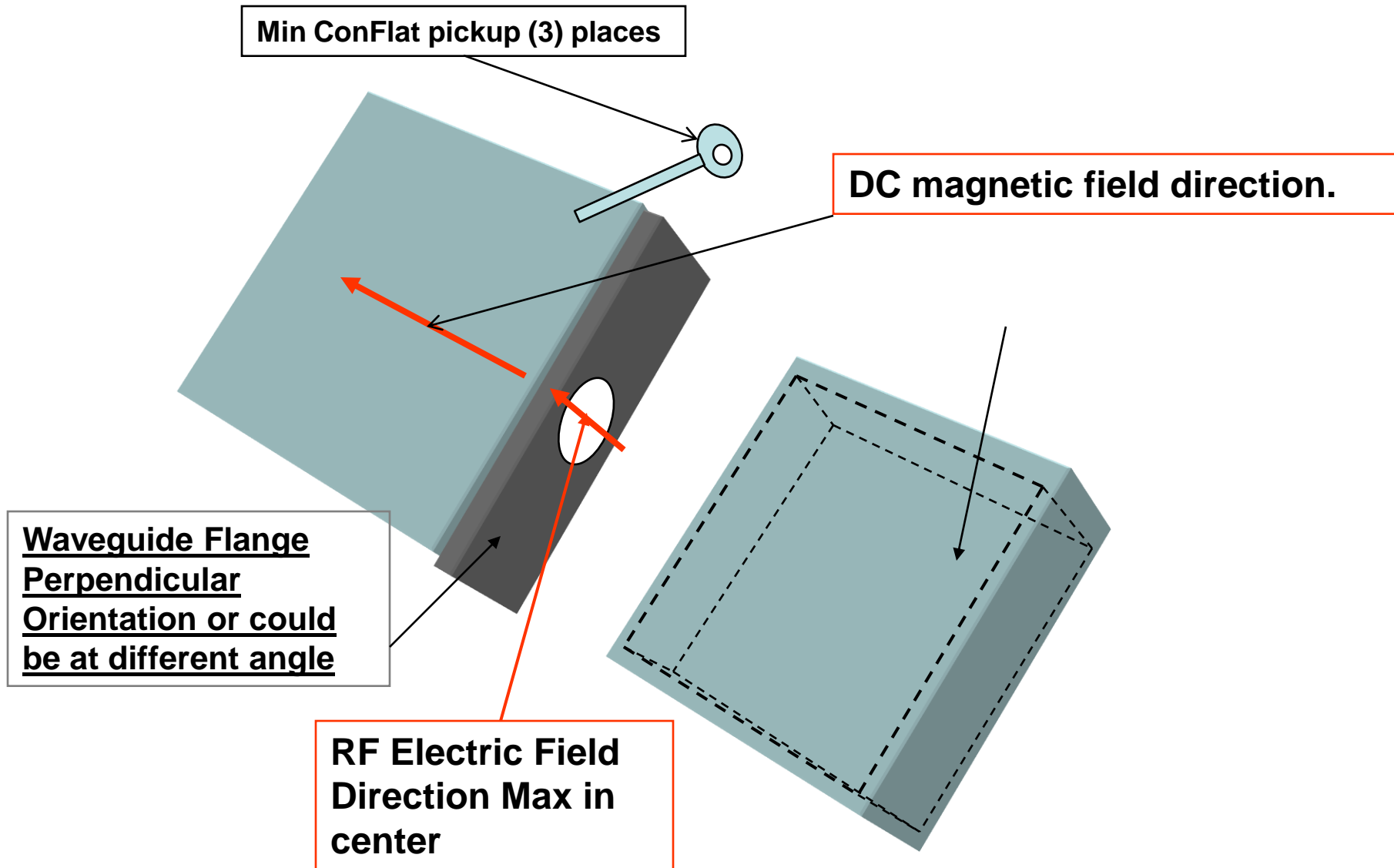


805 MHz Box Cavity Status
Fridays Collaboration Meeting
05/29/09
Al Moretti

Outline :

- **Description of the Box cavity Concept.**
- **Box Cavity Summary Plans.**
- **HFSS Model of the cavity.**
- **CAD Drawings.**
- **Specifications.**
- **Qo, Resonant Impedance, Power requirements, peak surface fields.**
- **Status.**

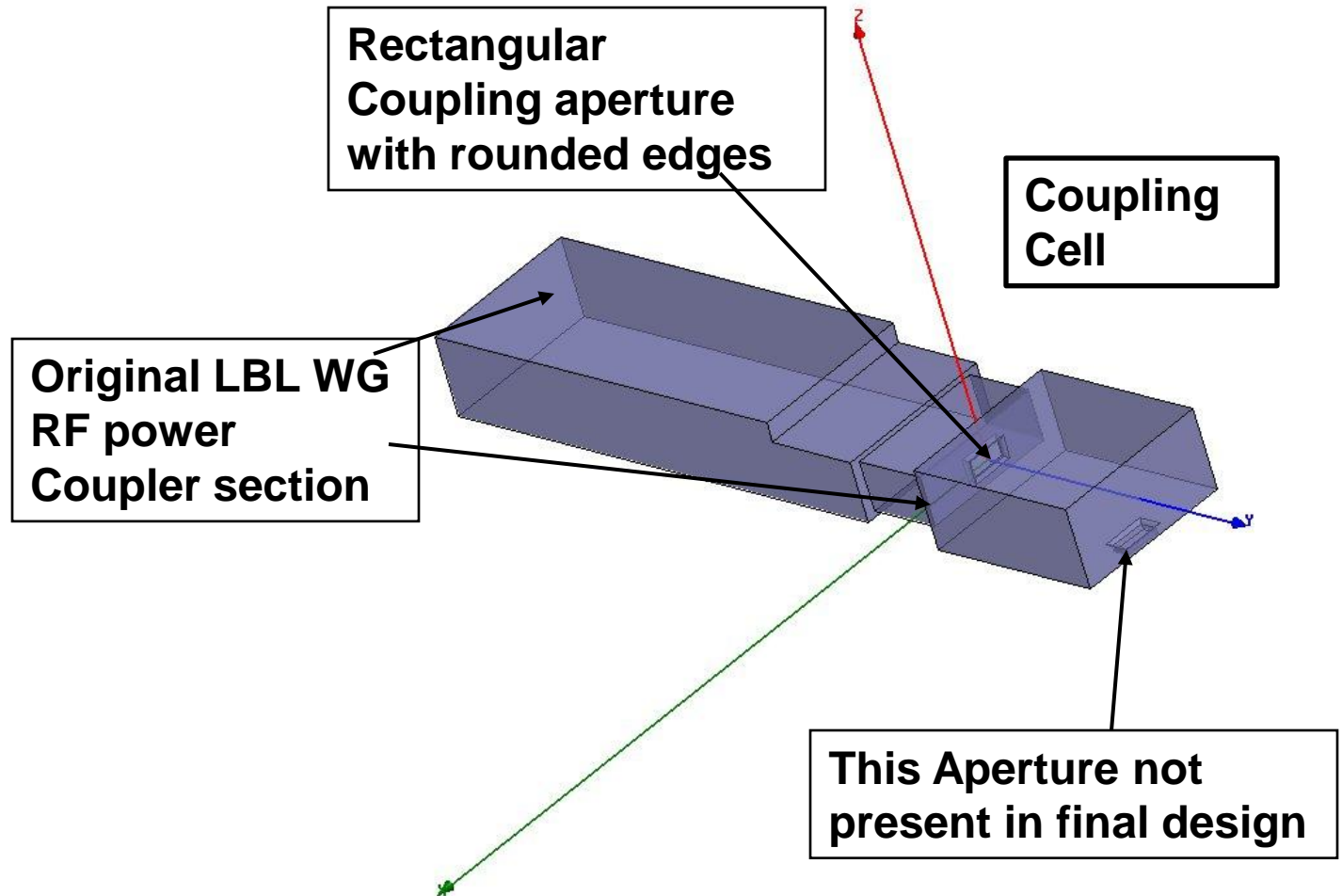
Simplified View of Box Cavity for Field Orientation Studies



Box Cavity Summary Plans:

- Rectangular box cavity will be made of 101 OFE copper plates. Parts and best HFSS simulation coupling aperture will be machined into parts with 32 μ inch finish. Then the sides will be screwed and foil hydrogen brazed together, First Braze Cycle; Making 2 cavities X Fields types. New question can we make the second cavity parallel fields type and get 15 Degree rotation.
- This will come back to Fermilab and be finish machined for foil brazing of top and bottom plates; Water cooling channels will have been gun drilled into plates . Top and bottom plates we be electro polished. If required Coupling aperture will be trimmed after a RF cold test to determine Fo, Qo and near match coupling.
- Top and bottom plates, SS flange and viewing ports will be jigged in place and foil brazed together. This will be sealed and shipped back to Fermilab, Second Braze Cycle
- Another cold RF test will be made to determine Fo, Qo and coupling. Coupling aperture will be trimmed for near match condition if required.
- The rotating support fixture (upto 15 degrees) will be attached onto the current support frame.
- Vacuum system, drive waveguides, RF cavity pick-ups and after calibration testing will begin at 90 Degrees.

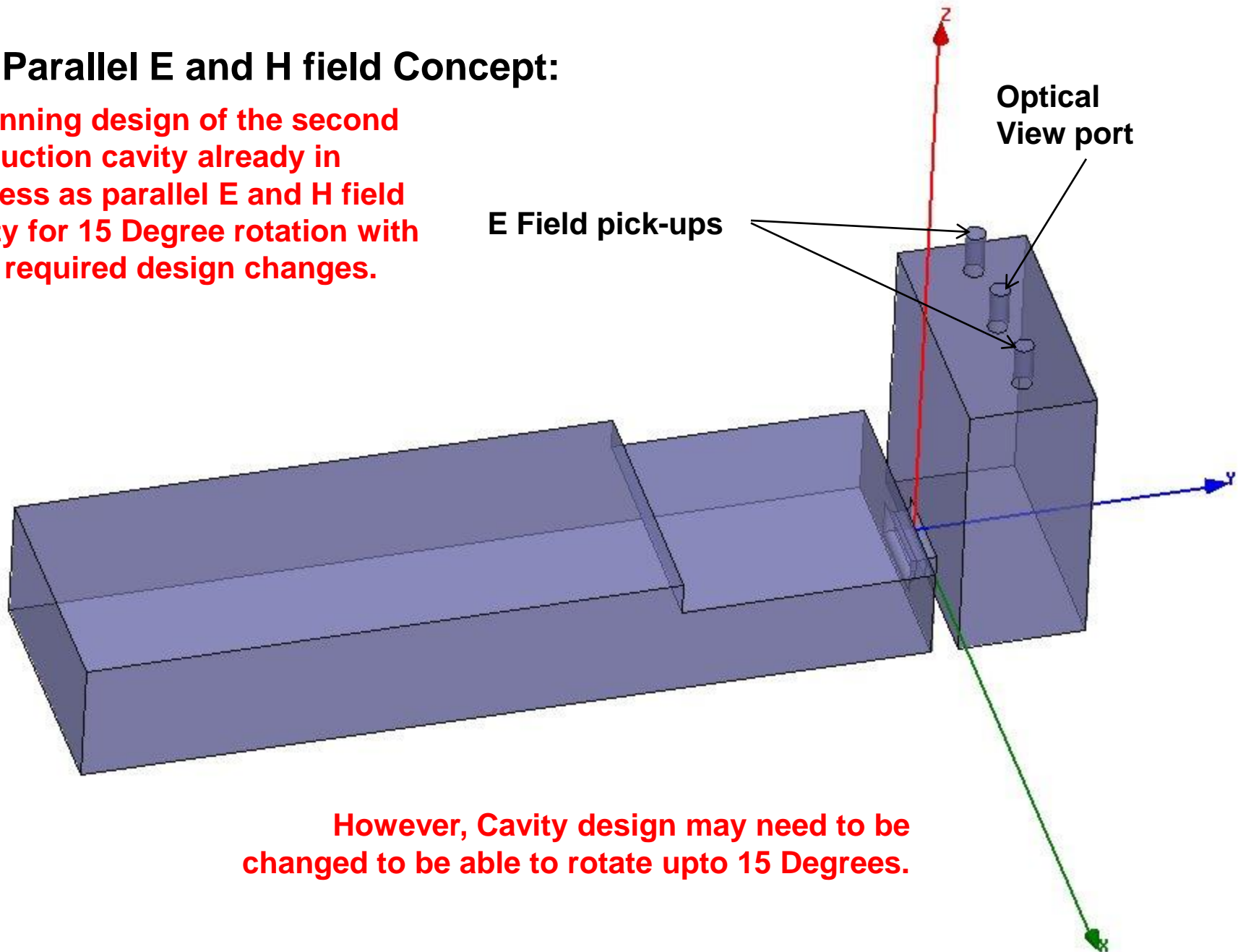
Orthogonal E and H Case



HFSS Model showing only inside dimensions of the RF cavity and WG coupler

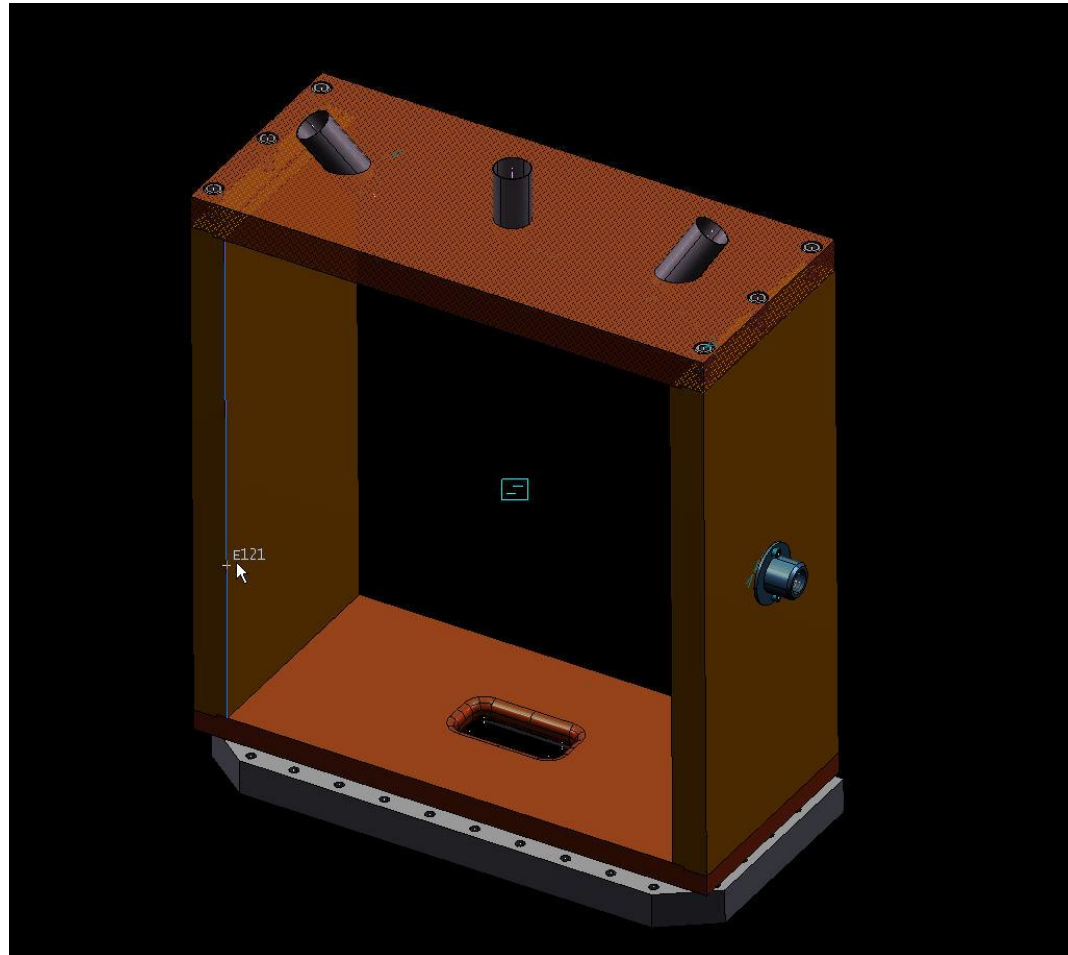
Parallel E and H field Concept:

Beginning design of the second production cavity already in process as parallel E and H field cavity for 15 Degree rotation with little required design changes.



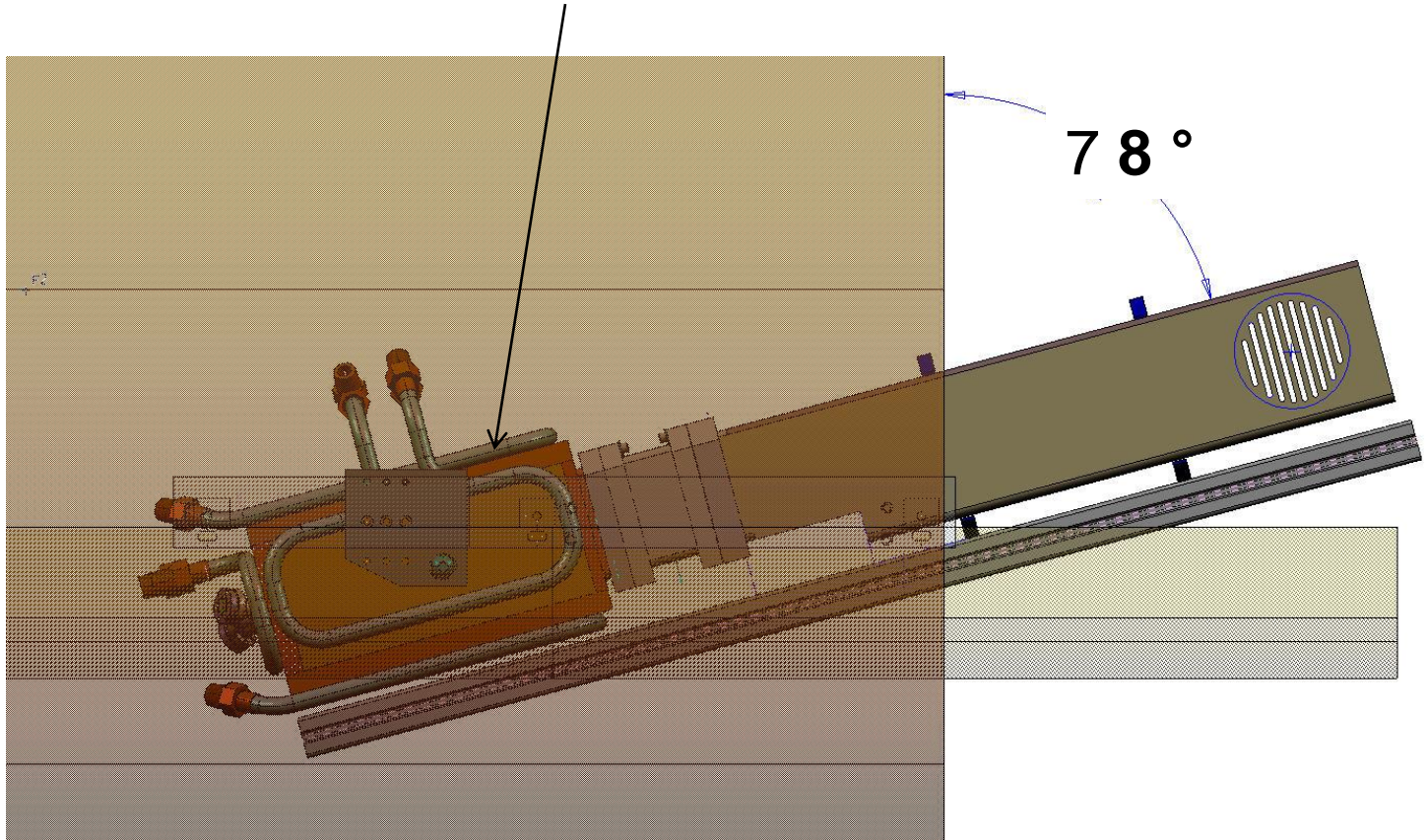
However, Cavity design may need to be changed to be able to rotate upto 15 Degrees.

First Braze Cycle



Box Cavity Attached to Waveguide and rotation Assembly.

Note: The external water cooling tubing have been replaced by gun drilled holes in the top and bottom plates. This saves time and effort later and also improves the cooling efficiency.



Specifications

The following are some of the specs for the square cavity:

Tolerance of parts = ± 0.005 "

Inside finish = 30 u inches

Average power = 5 kW with half the power dissipated equally on the Top and bottom plates the remainder almost equally on the 4 sides.

Pick-up ports: Three min-ConFlat vacuum feed-thru ports in the side opposite the coupling aperture, 2 with field pick-up loops and one with a Sapphire vacuum viewing window on a mini Con Flat flange.

Temperature: Max. temperature on inside surface of the un-cooled coupler aperture is $+37.2^{\circ}\text{C}$ at 5 kW with room temperature water circulating in the cooling tubes. The other max temperatures are at center of top and bottom plates is 38.1°C and 43.1°C on the long side plate.

Rotation Angle: $90 + \Delta 12$ Degrees, need to lower the center of cavity vertically 3.8 cm to achieve 15 Degrees.

Schedule and Cost estimate

Schedule

Schedule Comments

➤ Detailed drawings completed	----- 1 week	
➤ Procurement of materials Cu plates	----- 2 weeks	
➤ Machining parts for first braze cycle	----- 3 weeks:	At the machine shop, this week.
➤ First hydrogen braze cycle	----- 2 weeks	
➤ Machine parts for second braze cycle	----- 1 week	
➤ Second braze cycle	----- 1 weeks	
➤ Cold test and attach rotation structure	----- 1 week	
➤ Installation in magnet with vacuum and RF	----- 1 week	
	Total 12 weeks with high priority!	

➤ Material copper plate	----- \$2000
➤ 2 braze cycle	----- 4000
➤ Machining of parts	----- 10000
➤ Miscellaneous material and parts	----- 4000
	Total = \$ 20,000 x 2 = \$40,00

Calculated Parameters of the cavity and cavity dimensions

HFSS normalizes all parameters to 1 W of input power to the waveguide coupler and solves for the frequency, gradient, coupling factor, Q_0 (in cavity mode) etc.

1W produces a gradient of 25 kV/m by scaling:

25 MV/m would take 1 MW ideal.

The Impedance across the center of the cavity is

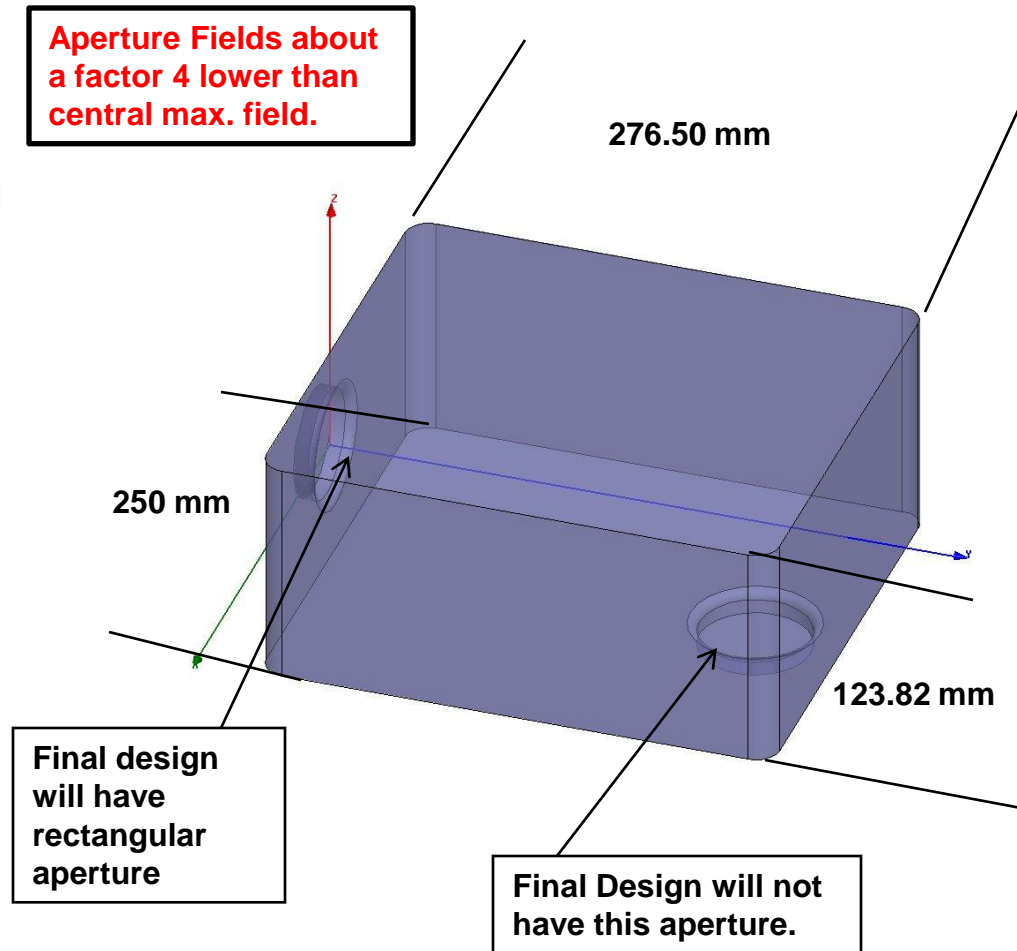
$$\text{Imp} = 9.5 \text{ M}\Omega.$$

This is the resistance across the center of the cavity given by

$$\text{Imp} = (\text{gap Voltage})^2 / 1 \text{ W}.$$

This uses the peak voltage and is in agreement with SuperFish and most published accelerator designs.

$$Q_0 = 27,400.$$



Status

- The parts for 2 orthogonal box are at a satellite machine shop and should be completed in about 2-3 weeks if no major design changes are made in the drawings.
- Began looking at the design of the parallel box cavity and its rotation possibility without major design changes other than the position and size of the coupling aperture. If acceptable could make the second cavity in process parallel instead of orthogonal.
- Design of the supporting and rotating hardware is about 90 % complete. Need to design the waveguide transition pieces for the rotation angle or angles. Looking at straight pieces with proper angled CPR975 flanges.
- The fabrication is on schedule **with high priority** for the cavity to be operational in 8 to 10 weeks.